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Case Analysis of Hypokalemia Induced by Irbesartan-Hydrochlorothiazide: A Case Study

Wenyuan Yang*

Department of General Internal Medicine, Branch of Haitian Hospital of Integrated Traditional Chinese and Western Medicine, Bengbu 23300, Anhui Province, China

***Corresponding author:** Wenyuan Yang, ywyzs2@126.com

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Abstract: Irbesartan-hydrochlorothiazide is a commonly used antihypertensive drug, but potential adverse reactions such as hypokalemia should not be overlooked. This study analyzes a case of hypokalemia induced by irbesartan-hydrochlorothiazide, exploring the drug's association with hypokalemia and clinical treatment strategies. The patient experienced symptoms of muscle weakness and palpitations after taking irbesartan-hydrochlorothiazide and was diagnosed with hypokalemia through laboratory tests. Reviewing the patient's medication history and disease progression, it was hypothesized that the drug's potassium-wasting effect was the direct cause of the hypokalemia. After discontinuing the medication and initiating potassium supplementation, the patient's potassium levels returned to normal, and symptoms significantly improved, further confirming the link between hypokalemia and the medication. This case suggests that clinicians should consider the risk of hypokalemia when treating hypertension, especially in patients with chronic kidney disease, the elderly, or those at risk for electrolyte disturbances. For patients who have already developed hypokalemia, potassium supplementation and adjustment of the treatment regimen are recommended to prevent further deterioration. Timely discontinuation of potential causative drugs is also advised. In summary, ensuring medication safety and preventing potential complications has significant clinical importance in recognizing and managing hypokalemia induced by irbesartan-hydrochlorothiazide. Future research should focus on optimizing treatment protocols and developing more effective strategies for preventing and managing related adverse reactions to improve patient quality of life.

Keywords: Irbesartan-hydrochlorothiazide; Hypokalemia; Case study; Drug-related adverse reactions; Blood pressure management

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1. Background and objectives of the study

Hypertension, as a chronic disease, poses a significant threat to patients' quality of life and lifespan due to its associated complications, such as cardiovascular and cerebrovascular diseases, making it a major global public health challenge. Therefore, effective antihypertensive drug treatment is essential for reducing mortality and improving patients' quality of life. Due to its strong antihypertensive effects and relatively low rate of adverse reactions, particularly in patients who do not respond well to monotherapy, the combination drug irbesartan-

hydrochlorothiazide is widely used in clinical practice [1]. However, while irbesartan itself has potassium-sparing properties, its combination with hydrochlorothiazide, which has diuretic effects, may lead to a decrease in blood potassium levels, resulting in hypokalemia.

Hypokalemia, as one of the common electrolyte disturbances in clinical practice, can lead to symptoms such as muscle weakness and arrhythmias, and in severe cases, it can be life-threatening. Medications are one of the primary causes of hypokalemia, and the potential risk of hypokalemia induced by irbesartan-hydrochlorothiazide, a commonly used antihypertensive drug, should not be overlooked. However, current research on the relationship between irbesartan-hydrochlorothiazide and hypokalemia is insufficient, especially in clinical practice, where both physicians and patients need to improve their awareness and response strategies regarding this potential risk.

The purpose of this study is to conduct an in-depth analysis of a case of hypokalemia induced by irbesartan-hydrochlorothiazide, exploring the correlation between the drug and hypokalemia, and providing practical insights for clinical physicians. By examining the patient's medical history, medication use, disease progression, and treatment measures, this study aims to provide evidence for understanding the possible mechanisms behind the occurrence of hypokalemia. The study will observe the recovery of potassium levels following the discontinuation of the drug and potassium supplementation, further confirming the causal relationship between the drug and hypokalemia. Through this research, the study seeks to offer more scientifically valid references for clinicians in the prevention and treatment of hypokalemia.

The study will also focus on how clinicians can balance the antihypertensive effects of medication with potential side effects, particularly in patient populations at risk for electrolyte disturbances, and make necessary adjustments in drug selection and management strategies to reduce the likelihood of hypokalemia. This research aims to provide valuable guidance for clinicians in their decision-making process, improve medication practices, reduce the risk of potential complications for patients, and provide empirical evidence for future studies on the safety and efficacy of related drugs, ultimately promoting the improvement of hypertension treatment regimens.

2. Correlation between hypokalemia and irbesartan-hydrochlorothiazide

2.1. Pharmacological effects of irbesartan-hydrochlorothiazide

The pharmacological effects of irbesartan-hydrochlorothiazide are primarily attributed to its two active ingredients—irbesartan and hydrochlorothiazide. While these drugs can effectively lower blood pressure, they also pose a potential risk of causing hypokalemia.

Irbesartan, as an angiotensin II receptor antagonist, mainly functions by blocking angiotensin II from binding to the AT1 receptor. Angiotensin II is a potent vasoconstrictor that works by constricting blood vessels and increasing peripheral resistance, thereby raising blood pressure. By antagonizing its effects, irbesartan induces vasodilation, reduces peripheral resistance, and consequently lowers blood pressure. Additionally, irbesartan can indirectly reduce sodium reabsorption in the kidneys by inhibiting the production of aldosterone, which in turn decreases potassium excretion, thereby providing a potassium-sparing effect.

Hydrochlorothiazide, on the other hand, primarily acts on the distal convoluted tubule of the kidney as a medium-strength diuretic. By inhibiting the reabsorption of sodium and chloride, it increases urine output, thereby reducing blood volume and indirectly lowering blood pressure [2]. However, hydrochlorothiazide's effect of reducing potassium reabsorption may lead to the loss of potassium ions, potentially causing or exacerbating hypokalemia, while simultaneously promoting the excretion of sodium and chloride.

When these two drugs are used in combination, irbesartan's potassium-sparing effect can partially offset

hydrochlorothiazide's potassium-excreting effect. However, this does not completely eliminate the risk of hypokalemia, especially in patients with other risk factors for electrolyte imbalances, such as chronic kidney disease, age-related decline in kidney function, and drug interactions.

Therefore, when prescribing irbesartan-hydrochlorothiazide for hypertension treatment, clinicians must thoroughly assess the patient's potential risk for developing hypokalemia and regularly monitor their blood potassium levels. Additionally, based on the patient's specific condition, adjustments in medication dosage or alternative treatment options may be necessary to reduce the likelihood of hypokalemia. Educating patients about the possible side effects of the medication and improving their ability to recognize early symptoms of hypokalemia can also help mitigate the harm that hypokalemia may cause. Through these measures, the adverse impact of hypokalemia on patients can be effectively reduced.

2.2. Studies on the association between irbesartan-hydrochlorothiazide and hypokalemia

Among the many drugs that can induce hypokalemia, irbesartan-hydrochlorothiazide has drawn significant attention due to its widespread use and potential potassium-excreting effects. Although irbesartan itself has potassium-sparing properties, its combination with hydrochlorothiazide in this compound preparation may disrupt the balance of potassium ions in the body while lowering blood pressure. Studies have shown that the use of irbesartan-hydrochlorothiazide is significantly associated with the incidence of hypokalemia, particularly in high-risk groups such as elderly patients, those with chronic kidney disease, and individuals taking other medications that may cause hypokalemia.

The association between irbesartan-hydrochlorothiazide and hypokalemia is not coincidental; multiple clinical trials and observational studies have provided evidence supporting this link. These studies have found that the incidence of hypokalemia is significantly higher in hypertensive patients using irbesartan-hydrochlorothiazide compared to those using irbesartan or hydrochlorothiazide alone [3]. Additionally, case reports have indicated that discontinuation of irbesartan-hydrochlorothiazide can significantly improve hypokalemia, further confirming the causal relationship between the drug and hypokalemia.

Retrospective analyses and cohort studies examining individual factors that may contribute to irbesartan-hydrochlorothiazide-induced hypokalemia have led researchers to recognize certain factors that may increase the risk of hypokalemia, such as age, gender, kidney function, cardiovascular disease history, baseline potassium levels, and concomitant medications. Additionally, research on these factors related to hypokalemia has helped identify possible preventive strategies, such as adjusting medication doses, choosing different types of diuretics, or adding potassium-sparing medications when necessary to reduce the likelihood of hypokalemia. These studies have also provided some potential preventive medications.

Nevertheless, existing studies still have certain limitations, including sample size constraints, varying observation periods, and differences in patient compliance. Therefore, future research needs to be conducted on a larger sample basis with prospective designs to more accurately assess the association between irbesartan-hydrochlorothiazide and hypokalemia and to further explore potential mechanisms. This will help clinicians gain a deeper understanding of the interaction between the drug and hypokalemia and provide more specific and personalized treatment recommendations to achieve safer and more effective blood pressure management. Through this research, a scientific basis for better hypertension prevention and treatment can be provided.

Research on the association between irbesartan-hydrochlorothiazide and hypokalemia is an important topic in the field of hypertension treatment. There is evidence that this compound drug may increase the risk of hypokalemia, especially in certain patient populations. However, by employing refined clinical management strategies, the occurrence of hypokalemia can be effectively controlled, ensuring the safety and satisfaction of

patients. This topic is currently awaiting more high-quality research to further reveal and deepen understanding. Therefore, there is an urgent need to optimize the selection of antihypertensive drugs and develop rational medication regimens.

3. Case description and diagnosis/treatment process

3.1. Patient information and medical history

The patient, Ms. Wang, is 92 years old, weighs 59 kg, and is 159 cm tall, with a BMI of 23.3. Ms. Wang has had hypertension for several decades. Initially, her blood pressure was well-controlled with irbesartan alone. However, three years ago, due to suboptimal blood pressure control, her treatment was adjusted to a daily dose of 150 mg/12.5 mg irbesartan-hydrochlorothiazide. After the medication adjustment, her blood pressure stabilized, although she occasionally experienced mild fatigue in her lower limbs, which did not raise significant concern.

Ms. Wang has no history of severe chronic kidney disease, but she does have osteoporosis and has been taking calcium supplements and vitamin D for an extended period to maintain bone health. Clinically, she has considerable experience with no severe underlying conditions, no history of allergies, and good adherence to medications.

During the initial phase of taking irbesartan-hydrochlorothiazide, Ms. Wang did not undergo routine electrolyte testing, only regular blood pressure and blood sugar monitoring at the hospital. Over the past two months, she began experiencing palpitations and fatigue, which affected her daily activities, as well as muscle weakness, particularly in her lower limbs. An electrocardiogram (ECG) showed sinus bradycardia with a heart rate of 55 beats per minute, ventricular premature beats, and other findings. Given the worsening symptoms, Ms. Wang was transferred to a central hospital for further diagnosis and treatment.

Upon detailed inquiry into her medical history, the physician noticed that her symptoms were consistent with those of hypokalemia, leading to a blood potassium test. The results revealed that Ms. Wang had low blood potassium levels, with a reading of 2.66 mmol/L, significantly below the normal range, leading to a diagnosis of hypokalemia. As there were no significant changes in her lifestyle or other medications, the continued use of irbesartan-hydrochlorothiazide was identified as the likely primary cause of her hypokalemia. Ms. Wang's condition has since become a significant concern, and a targeted treatment plan has been initiated, along with medication adjustments.

3.2. Clinical manifestations of hypokalemia induced by irbesartan-hydrochlorothiazide

Ms. Wang's hypokalemia gradually worsened, significantly affecting her quality of life. Initially, she experienced lower limb weakness, resulting from decreased muscle contraction ability due to low potassium, which impaired her ability to walk and engage in daily activities. As her condition progressed, she began to experience palpitations, a result of electrolyte imbalance caused by low potassium. Since potassium plays a crucial role in maintaining the stability of myocardial cell electrophysiological activity, hypokalemia can increase myocardial excitability, leading to arrhythmias such as premature beats and atrial fibrillation, posing a significant health risk to the patient.

The disruption of intracellular potassium on energy metabolism can lead to fatigue. Since potassium is involved in energy production processes such as glycolysis and oxidative phosphorylation, hypokalemia reduces cellular energy supply, causing general weakness. Ms. Wang's osteoporosis may be partially related to hypokalemia—since potassium, along with calcium and magnesium, helps maintain bone health, low potassium

can indirectly affect bone metabolism, worsening osteoporosis. Although irbesartan itself has a potassium-sparing effect, the diuretic effect of hydrochlorothiazide may lead to potassium loss, resulting in an overall loss of potassium ions in the body.

In summary, Ms. Wang's symptoms of hypokalemia are consistent with the pharmacological effects of irbesartan-hydrochlorothiazide, especially the diuretic effect of hydrochlorothiazide, which can lead to potassium ion loss. This highlights the importance for doctors to closely monitor electrolyte levels when using irbesartan-hydrochlorothiazide, especially in elderly patients, those with chronic kidney disease, and individuals taking other medications that may affect electrolyte balance. Timely monitoring and assessment can aid in the early detection and treatment of hypokalemia, preventing its further deterioration and the development of severe complications.

4. Conclusion

This case study offers a detailed analysis of hypokalemia induced by irbesartan-hydrochlorothiazide, investigating the correlation between the medication and hypokalemia, and evaluating the effectiveness of clinical treatment strategies. The study reveals that while the combination of irbesartan-hydrochlorothiazide generally benefits blood pressure control, its potential potassium-depleting effect can lead to decreased blood potassium levels, especially in patients at risk for electrolyte imbalances. Therefore, special caution is advised for these patients.

Although irbesartan has a potassium-sparing effect that can partially counteract the potassium-depleting effects of hydrochlorothiazide, this mitigation is not complete. The risk of hypokalemia increases, particularly in patients with compromised kidney function, chronic diseases, or those concurrently taking other medications that may induce hypokalemia. Thus, when using irbesartan-hydrochlorothiazide to treat hypertension, clinicians should not only focus on its antihypertensive effects but also thoroughly assess the patient's risk of hypokalemia, adjusting the drug selection, dosage, or treatment plan accordingly to minimize the occurrence of hypokalemia [4].

Ms. Wang developed symptoms of muscle weakness and increased heart rate after using irbesartan-hydrochlorothiazide. Laboratory tests confirmed hypokalemia. After discontinuing the medication and administering potassium supplements, her blood potassium levels were effectively corrected and restored. This further confirms the direct link between hypokalemia and the use of the drug, underscoring the importance of regularly monitoring electrolyte levels and promptly discontinuing and treating medication-induced hypokalemia when detected. This case also provides a valuable reference for the diagnosis and treatment of hypokalemia in clinical settings.

The conclusions of this study offer significant guidance for clinical practice in two key areas. First, they highlight the need for clinicians to consider the impact of antihypertensive drugs on electrolyte balance, especially in high-risk patient groups, such as the elderly, those with chronic kidney disease, and those undergoing polypharmacy. Second, educating patients about medication risks can help them recognize and address potential adverse effects, improving their awareness of hypokalemia symptoms and enabling early intervention. Consequently, the findings of this study provide useful insights for the evaluation and application of related medications in clinical practice.

To enhance the prevention and management of hypokalemia induced by irbesartan-hydrochlorothiazide, future research should explore the following directions: first, identify safer antihypertensive drug combinations and rationally control drug dosages; second, investigate the varying responses to medications across different

age groups, genders, and ethnicities to achieve more precise medical management; additionally, deepen the understanding and application of the relationship between drugs and hypokalemia in clinical practice to further reduce the incidence of drug-induced hypokalemia. Ultimately, these efforts aim to improve the safety and effectiveness of hypertension treatment, enhance patients' quality of life and life expectancy, and contribute to the advancement of medical science. This research also provides valuable insights and guidance for future studies.

Disclosure statement

The author declares no conflict of interest.

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